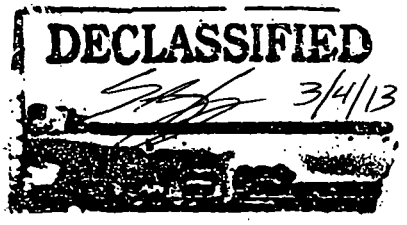

F O R E W O R D

This document has been prepared by the Radiation Protection Bureau to provide the Director, Environmental Improvement Division, adequate information to make a determination on whether to approve the issuance of a Radioactive Material License for a uranium mill to be operated as proposed by Bokum Resources Corporation, in their amended application.

JANUARY 25, 1980

Radiation Protection Bureau
Environmental Improvement Division
Health and Environment Department
State of New Mexico

FOREWORD

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SUMMARY AND CONCLUSIONS

The application for a Radioactive Material License by Bokum Resources Corporation to operate a uranium mill and the below-grade tailings impoundment has been reviewed by the Radiation Protection Bureau, Environmental Improvement Division. The application was extensively revised and amended during the review process.

A public announcement of the EID acceptance of Bokum's uranium mill application was made on August 3, 1978. The application was made available for public review in Santa Fe, Albuquerque, and Milan. Considerable public interest was demonstrated during the review process. Numerous comments were received and responded to by both the applicant and EID. Two public hearings were conducted on a Ground Water Discharge Plan.

As a result of these reviews and investigations conducted by the Radiation Protection Bureau staff, the information available at this time is inconclusive concerning the radiological impacts of the proposed facility. Additional radiological assessments review must be accomplished to demonstrate conclusively that there is no significant radiological impact to the population or undue risk to property. Preliminary information available at this time would indicate that the subject mill, located at Marquez, New Mexico, if operated in accordance with the proposed license conditions could be expected to afford adequate protection to the health and safety of the nearby population and no undue risks to property. Operational radiological monitoring is required to check the calculations. Any operations indicating radioactivity concentrations above maximum permissable levels will necessitate immediate corrective action by the licensee. Operations by the licensee cannot be accomplished for several weeks. Therefore, additional radiological assessment calculations can be accomplished by both the applicant and the Division to evaluate any potential radiological risk.

It must be recognized by all concerned that this tailings impoundment is the first below-grade tailings disposal system in an erosional environment such as exists in much of New Mexico. While the general disposal scheme meets the Nuclear Regulatory Commission guidance that "The prime option for tailings disposal is below grade", extensive public testimony and staff review clearly highlighted the New Mexico site specific potential for erosion and the attendant problems posed by the need for long-term stabilization and reclamation. Because of the experimental nature of this tailings disposal method, considerable effort had to be devoted to evaluation of potential troublesome technical problems and devising licensing conditions that would enable proper regulatory review and evaluation coupled with adequate control and reporting procedures with a minimum of interference in the operators activity. The following outline will identify the major issues associated with this application and the environmental protection safeguards available to eliminate, minimize or control potential insults to the environment or the population.

ENVIRONMENTAL PROTECTION SAFEGUARDS

MILL COMPLEX

ORE STORAGE

Airborne Radioactivity Release -

- Ore Delivered to Mill with 8-10% Moisture
- Water Spray to Reduce Dusting to Minimum
- Restricted Area Fence Located to Minimize Airborne Concentrations

Seepage -

- Ore Pads Constructed to Minimize Seepage into Ground
- Surface Drainage Collected in Sump and Discharged to Tailings Evaporation Ponds

GRINDING

- Wet Ore Reduces Dusting
- Semi-Autogenous Grinding (Wed Grinding)
- Scrubber Used to Remove Ventilation Dust
- Provisions for Sampling and Monitoring

LEACHING CIRCUITS

- Ventilation to Remove Leach Gases (Non-Radioactive)
- Scrubber Used to Minimize Vapors
- Berms Around Tanks to Collect Any Escaping Solution
- Drains Leading to Collection Sump and Discharged to Tailings Evaporation Ponds

YELLOWCAKE DRYING AND PACKAGING AREA

- High-Effiency Wet Scrubber
- Recycled Scrubber Effluent
- Dry Dust Collector in Packaging Area
- Packaging Area With Smooth Walls for Washdown
- Drain Collection for Recycling
- Provisions for Sampling and Monitoring

MISCELLANEOUS WASTES

- Laboratory Wastes to Collection Sump

- Contaminated Laundry Wastes to Collection Sump

TAILINGS DISTRIBUTION LINES

- Thick Walled PVC (Minimum Joints Used)
- Lines Behind Berms or Drain Directly from a Break into Ponds or Trenches
- Lines Within Ground Contours so they are Behind Drainage to Large Secondary Catchment Dam
- Lines Above PMF Flood Pool Elevation
- Lines Crossing Canyons and Arroyos - Have Metal Channels Draining to Either Side and Behind Berms Graded to Sumps that are Sized to Handle 12 Hours of Line Flow and Keep Any Line Break Out of Canyons and Arroyos
- No Single Operator Handling Tailings
- Communication Link with Mills
- Daily Inspection

TAILINGS TRENCHES

- Within Drainage Controlled by Secondary Catchment Dam
- Tailings Below Grade
- Tailings Below Bottom of Surficial Alluvium
- Final Liquid Level 10 Feet Below Top of Tailings Solids
- 300 Feet Minimum Distance Away from Canyons and Arroyos
- Solids/Liquid Separation by Decantation
- Base of Trenches in Unweathered Mancos Shale
- Minimum Head for Seepage
- Laboratory Tests Indicate Minimum Possibility of Seepage Through Mancos Shale
- No Construction Without Division Approval
- No Use Without Inspection and Division Approval
- No Closing Without Inspection and Division Approval
- Inspection Before Use for Fractures-Decision if Lining or Grouting Required
- On-going Staged Reclamation
- Interim Coverage Possible to Minimize Blowing of Tailings Sands and Radon Release
- Final Slope 1:10 or Less Steep
- Site Location Requires Division Approval
- Daily Inspection
- Annual Stability Analysis for Trench Walls
- Additional Hydrological Investigation and Drilling Prior to Final Siting
- Monitor Wells for Seepage Detection
- No Evaporation Pond Over Trench #1 (Initial Condition)

EVAPORATION PONDS

- No Construction Without Division Approval
- Within Drainage to and Behind Secondary Catchment Dam
- Incised Below Grade into Weathered Shale or Compacted Mancos Shale
- 5-Foot Thick Compacted Clay Liner
- Ponds Not Permanent - Contaminated Material Removed and Deposited in Last Open Trench
- Maintain Adequate Freeboard
- Freeboard Gages
- Monitor Wells for Seepage Detection
- Daily Inspection

SECONDARY CATCHMENT DAM

- Compacted Clay Core Engineered Structure
- Supervised by Registered Professional Engineer Approved by State Engineer
- Annual Structural Stability Analysis Required
- Only Required During Operational Life of Tailings Site
- Opened During Reclamation to Allow Original Stream Flow
- Final Elevation Sufficient to Hold a Probable Maximum Flood (6' to 8' Freeboard Above Maximum Flood Pool)
- Clay Filled Dike Stops Uncontrolled Groundwater from Leaving Area
- Sump for Collection of Surface and Groundwater Drainage
- Pump to Discharge Sump Liquid Downstream or to Evaporation Ponds
- Periodic Maintenance
- Daily Inspection

DIVERSION DIKE

- Directs PMF Around Site During Operational Life of Site
- Cut-Off Barrier Below Dike to Stop Groundwater Flow Into Site
- Opened After Reclamation
- Engineered Structure
- Protected by Rip-Rap in Critical Areas
- Annual Stability Analysis
- Daily Inspection
- Periodic Maintenance
- Supervised by Registered Professional Engineer

RECLAMATION

- Test Plots Start Immediately to Determine Stable Slope Configuration
- Trench #1 Part of Controlled Experiment
- Final Slopes No Steeper Than 1:8
- Maximum Effort to Restore Natural Drainage
- Arroyo Hondo, Unnamed Arroyo Diverted into Canyon de Marquez
- Slopes Toward Non-Trench Areas

RECLAMATION (cont'd)

- Head Cutting of Arroyos Controlled
  - Filled With Mancos Fill
  - Clay Plugged at Canyon/Arroyo
  - Rip-Rap at Canyon /Arroyo
- Canyon de Marquez Base Level Established By Survey
- Test Plots Under Control of Range Specialist
- Annual Report
- Fencing to Minimize Wild Animal Intrusion

GENERAL

- Operational Monitoring for Radioactivity
- Semi-Annual Reports of Radioactivity Released from Site
- Perimeter Fences Posted
- No Transfer of Mill Tailings Without Approval
- Continued Care Fund
- Annual Land Use Survey and Report
- Ownership of Tailings and Acceptable Property Rights Approved by Division
- Quarterly Aerial Photos Required for First Year, Then Semi-annually
- Must Comply with Groundwater Discharge Plan Requirements
- Emergency Response Plan Required by Six Months After License Issued
- Decommissioning Plan Required Prior to Termination of Operations

LICENSE CONDITIONS

License No. NM-BRC-ML-00

1. This license authorizes uranium ore processing and storage of uranium mill tailings solids and solution at the licensee's Marquez Uranium Mill at a maximum throughput no greater than 2,200 tons of ore per day in accordance with statements, representations and conditions of the licensee's application and correspondence. The authorized place of use is at the licensee's uranium milling facility located near Marquez, New Mexico.

2. The licensee is hereby exempt from the posting requirements of 4-220.E.2 of the New Mexico Regulations Governing the Health and Environmental Aspects of Radiation for areas within the mill provided all entrances to the mill are conspicuously posted in accordance with 4-220.E.2 and the words "ANY AREA WITHIN THIS MILL MAY CONTAIN RADIOACTIVE MATERIAL."

3. The licensee shall post the fence surrounding the tailings impoundment area with "No Trespassing" signs and signs reading "Any area beyond this fence may contain radioactive material."

4. The licensee shall immediately notify the Radiation Protection Bureau, Environmental Improvement Division, P.O. Box 968, Santa Fe, New Mexico 87503 by telephone and in writing of any failure in the tailings retention system or milling circuits which results in a release or threatened release of radioactive material into unrestricted areas. This requirement is in addition to the requirements of 4-420, New Mexico Regulations for Governing the Health and Environmental Aspects of Radiation.

5. The licensee shall determine that employees leaving work are not contaminated with radioactive material in accordance with procedures established by the Radiation Safety Program.

6. Mill tailings shall not be transferred from the disposal site for any purpose without specific prior approval of the Division obtained through application for amendment of this license.

7. The licensee shall submit a report to the Division within 60 days after January 1 and July 1 of each year specifying the quantity of each of the principal radionuclides released to unrestricted areas in liquid and in airborne effluents during the previous six months of operation. If quantities of radioactive materials released during the reporting period are significantly above the licensee's design objectives as found in the applicant's radiological assessment, the report shall include an explanation and description of corrective action.

8. The Director of the Division or his authorized representatives shall be allowed to enter the premises to inspect the radiation related activities at all times. Failure of the licensee to admit the Director or his authorized representatives shall constitute grounds for an immediate cease and desist order.

9. All mill and tailings impoundment operations shall be conducted in accordance with an approved Ground Water Discharge Plan.

10. No construction of the uranium mill tailings trenches and evaporation ponds shall be accomplished without specific written approval of the Division.

11. The licensee shall conduct and document on a form acceptable to the Division each calendar day at least one inspection of the tailings disposal site (trenches, ponds, lines, distribution systems, ground water sump, secondary catchment dam, diversion dike).

12. The licensee shall provide a reclamation plan to the Division for review and approval within 3 year of the license date. The licensee shall construct, stabilize and reclaim the tailings disposal trenches and ponds in conformance with proposals contained in the approved reclamation plan.

13. The licensee shall provide artificial lighting at the tailings trench being filled, tailings solids and solution distribution points and ground water sump transfer point.

14. The Division shall be informed promptly of any proposed mill circuit changes and any organizational changes affecting radiation safety or radiation safety management.

15. If any of the radioactive emission control equipment is inoperative, operations in those areas controlled by that equipment shall be suspended immediately.

16. A weekly inspection shall be made and documented by the licensee of all work and storage areas. A report shall be prepared on any items of non-compliance with operating procedures, license requirements or safety practices affecting radiological safety. Reports shall be available to the Division inspectors for review.

17. The licensee shall conduct an annual survey of land use (grazing, residences, wells, etc.) in the area within five miles of the mill and tailings disposal site. An annual report shall be submitted to the Division 60 days after January 1 and indicate any differences in land use from that described in the licensee's environmental report or the previous annual report.

18. Before engaging in any activity not previously evaluated by the Division, but under the Division's authority, concerning radioactive material containment and control the licensee shall prepare a safety and environmental evaluation of such activity for review by the Division.

19. If unexpected conditions or evidence of potential irreversible degradation to the environment are detected during mill operation or trench and pond construction or operations, the licensee shall provide to the Division an acceptable analysis of the problem and plan of action to eliminate or significantly reduce the degradation or harmful effects to the environment and obtain the Division's approval before implementation of the plan of action.

20. The licensee shall maintain a management control program which shall include use of management approved written operating procedures, reviewed and approved by the radiation safety officer or equivalent employed by the licensee, for all aspects of mill operations (including tailings disposal operations), covered by the radiation safety program and the environmental monitoring and control program. Written procedures pertaining to all radiation

associated activities performed in the restricted areas shall be available prior to operations and followed in each area when radioactive material is processed, handled or stored and shall be reviewed annually. In addition, for any work or maintenance in those areas for which there is no effective operating procedure and for any non-routine maintenance or repair work, a work permit signed by an operations supervisor and a radiation safety staff member shall be prepared before and used during performance of these activities.

21. Each 12 calendar months, an annual audit review shall be accomplished for all activities conducted with radioactive material and a report provided to the Division. All employee exposure data, effluent release data, environmental monitoring data and the management control program shall be reviewed and analyzed for trends, potential for lowering personnel exposures and effluent releases to as low as reasonably achievable. If equipment for effluent monitoring and exposure control is being used, the review shall determine that the use is proper and that the equipment is adequately maintained and inspected.

22. No transfer of possession of any portion of the licensee's site or facilities may be made without prior written authorization from the Division.

23. The Division shall be furnished copies of documentation provided to any other agency or organization which concerns radioactive material or radiological safety relative to any operations or facility covered by this license.

24. Prior to discharge of uranium mill tailings into excavated trenches, the secondary catchment dam, its abutments and the diversion system shall be completed.

25. Tailings disposal and run-off collection functions which depend on pumps, motors, electricity or generators shall have immediately available alternate power sources and back-up equipment items. At no time shall operators of the tailings disposal system be without communication links to the mill.

26. Prior to beginning operations authorized by this license, the licensee shall have obtained all applicable Division permits and approvals.

27. The Division will conduct a pre-operational inspection 30 days prior to the estimated operational date for the mill. The licensee shall provide the Division with at least 45 days advance notice of the estimated operational date.

28. Use and cover of each uranium mill tailings trench and evaporation pond shall be preceeded by a joint inspection by the licensee and the Division prior to such use or cover. Notice of intent to use or cover each trench or pond shall be provided in written notice by the licensee to the Division at least 30 days prior to such projected use or cover.

29. Uranium mill tailings shall be controlled so that blowing of tailings to unrestricted areas is minimized during the operational life of the disposal area.

30. The licensee shall provide to the Division aerial photography of the mill and tailings disposal area within 20 days of each of the following dates for the first year: January 1, April 1, July 1, and October 1. For the following years, semi-annually: January 1, and July 1.

31. The licensee shall comply with the EPA December 1, 1980 prospective annual dose limit of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as a result of planned discharges of radioactive material, radon and its daughters excepted. To meet this condition the Division may require the licensee to operate at decreased values from those contained in Part 4, New Mexico Radiation Protection Regulations.

32. Within six months of the effective date of this license, the licensee shall submit to the Division an emergency response plan for review and approval describing the administrative, and technical procedures to be used for responding to releases of radioactive material. The radioactive material releases will be assumed to result from realistic accident scenarios that are based on actual and hypothetical accidents at uranium mills of design and capacity similar to the licensees's.

33. Approved waste generating processes and mill tailings management practices may be subject to revision in accordance with (1) the conclusions of the final Generic Environmental Impact Statement on Uranium Milling presently being prepared by the U.S. Nuclear Regulatory Commission, (2) the Uranium Mill Tailings Radiation Control Act of 1978, (3) and any revision to New Mexico Regulations Governing the Health and Environmental Aspects of Radiation and the Division's findings based on a review by the Division staff and the reports of the Division's technical consultants.

34. For purposes of complying with Section 4-130B of the New Mexico Radiation Protection Regulations, the limits given in Column 1, Appendix A of Part 4 may be deemed to apply to exposures to the concentrations for 40 hours per week for a period of 13 weeks.

35. The applicant shall conduct a continuous meteorological monitoring program. The data obtained from this program shall be tabulated annually (no more than 12 months elapsed time) in a format approved by the Division and made available for inspection by the Division. Quality assurance procedures specified by the Division shall be followed.

36. Ore storage pads shall be constructed to minimize seepage and provide for collection of water drainage for transport to the uranium mill tailings site. Operational procedures shall be employed to reduce dust blowing from the stored ore.

37. The licensee shall comply with all applicable parts of the New Mexico Regulations Governing the Health and Environmental Aspects of Radiation.

38. The tailings disposal site (exclusion area) shall be enclosed by fencing designed to minimize animal intrusion.

39. The licensee shall accomplish annually (no more than 12 months elapsed time) a stability and safety evaluation in accordance with the guidelines of NRC Regulatory Guide 3.11 of the diversion system, secondary catchment dam, evaporation pond berms/walls and tailings disposal trench walls. A report shall be furnished to the Division within 30 days of the evaluation.

40. Prior to uranium mill tailings discharge, the licensee shall submit to the Division for review and approval a report summarizing all of the

preoperational monitoring data including the expanded stream sediment sampling program referenced in the licensee's letter dated January 12, 1980.

41. During uranium mill and tailings disposal operations, the licensee shall implement an operational radioactivity monitoring program approved by the Division. Quarterly reports of the radiation monitoring program shall be provided to the Division.

42. The licensee shall provide a decommissioning plan to the Division three years prior to termination of mill operations for review and approval.

43. Radioactive material shall only be used by individuals designated in writing by the Radiation Safety Officer, Richard R. LeClair.

44. The licensee shall provide to the Division aerial photographs of all areas affected by any tailings slurry or decant line break or any other spill of contaminated materials. Photographs shall be taken immediately after the spill and again after clean-up of the area. Those areas affected by the spill shall be outlined and identified on the photographs.

45. The licensee shall conduct additional radiological assessments using parameters acceptable to the Division. These assessments shall be accomplished and provided to the Division within 20 days from the license date for review. An acceptable radiological assessment is required prior to mill operations. The Division may require monitoring in addition to that required by condition 41 to demonstrate the licensee's capability of meeting regulatory limits.

1. INTRODUCTION

1.1 THE APPLICANT'S PROPOSAL

Pursuant to the Radiation Protection Act of the State of New Mexico, Section 274 of the Atomic Energy Act of 1974 as amended, and 3 - 300 the New Mexico Regulations Governing the Health and Environmental Aspects of Radiation, Bokum Resources Corporation (the applicant), on February 16, 1978, applied to the New Mexico Environmental Improvement Division (EID) for a Radioactive Material License to construct and operate a uranium processing mill. This mill, hereafter referred to as the Marquez Uranium Mill, will process ores from a company-owned mine located approximately two miles west of the proposed uranium mill site.

On June 18, 1979, the EID Director rejected Bokum Resource Corporation's Groundwater Discharge Plan. A new plan, submitted October 22, 1979, serves as a major addendum to the application for a Radioactive Material License.

The project will consist of construction and operation of a mill with a maximum throughput no greater than 2,200, tons of ore per day.

The applicant presently controls by lease recoverable ore reserves containing over 1,687,000 pounds of uranium as U_3O_8 equivalent annually. Ore used as mill feed will average 0.08 percent U_3O_8. The proposed operating schedule is 365 days per year. The applicant has designed for a 20-year project lifetime with production capacity of 2000 dry tons per stream day to a maximum design capacity of 2200 dry tons per stream day. Final yellowcake quality will assay about 96.3 percent U_3O_8.

Waste materials (tailings)from the mill will be produced at about 3,570 tons of liquids and solids per day. Sequential preparation, filling, and reclamation of tailings impoundment trenches are planned. Compared to conventional single dam impoundments, this disposal method will decrease the amount of tailings exposed (and radon exhaled) both during and after operation of the mill.

In accordance with guidance provided by the Radiation Protection Bureau (RPB) of the NMEID, the applicant has submitted an application for a Radioactive Material License (Form RPS 16), a Mill Radiation Safety Program, an Environmental Report (ER), and supplements to the ER in response to questions by the RPB staff.

1.2 BACKGROUND INFORMATION

The Marquez Uranium Mill, currently under construction, is located in northwestern New Mexico approximately 37 miles west northwest of Albuquerque, 33 miles northeast of Grants, and 20 miles north of Laguna Pueblo. The mill facility is located on the Juan Tafoya Land Grant on top of Mesa Marquez, Sandoval County, New Mexico, approximately 0.6 miles southeast of the town of Marquez. The tailings, disposal area will be located at the convergence of the Arroyo Hondo and Canon de Marquez extending through the La Laguna area and terminating at the secondary catchment dam, approximately 0.4 miles east of the mill. Uranium ore will be supplied from the Marquez mine, currently under development, two miles west of the mill.

The surface area of the project is owned by Juan Tafoya Land Corporation and leased by Bokum Resources Corporation. The mill will occupy about 31 acres. At the end of the proposed 20 year project lifetime, the tailings disposal trenches will potentially occupy approximately 548 acres.

The purpose of this paper is to summarize the radiological and environmental effects of the project as well as the monitoring and mitigating measures proposed to reduce the effects of the project on the immediate area and surrounding environs to levels below existing standards or as low as is reasonably achievable. This paper will provide the basis for the Director's determination concerning issuance of a Radioactive Material License for operation of the Marquez Uranium Mill.

2. ENVIRONMENTAL SETTING

2.1 SITE LOCATION

The site is located within the Laguna Mining District of the southern San Juan Basin.

The area surrounding the Marquez project site is sparsely populated. The town of Marquez, 0.6 miles northwest of the mill site and one mile northwest of the tailings area, has approximately 30 residents.

Table 1 lists the relationship of the more immediate communities to the project area.

Figure 1 shows map locations of the communities.

TABLE 1

LOCAL COMMUNITIES

Community	Approximate Distance in miles and Direction from site	Pop. (1974 est.)
Seboyeta	9.0 SW	175
Moquino	10.5 SSW	50
Bibo	11.0 SSW	120
Anaconda Housing (at Jackpile-Paguate Mine)	12.5 SSW	40
Paguate	13.0 SSW	500
Laguna	19.7 SSW	600
Mesita	20.5 S	75
New Housing south of Mesita	21.0 S	120

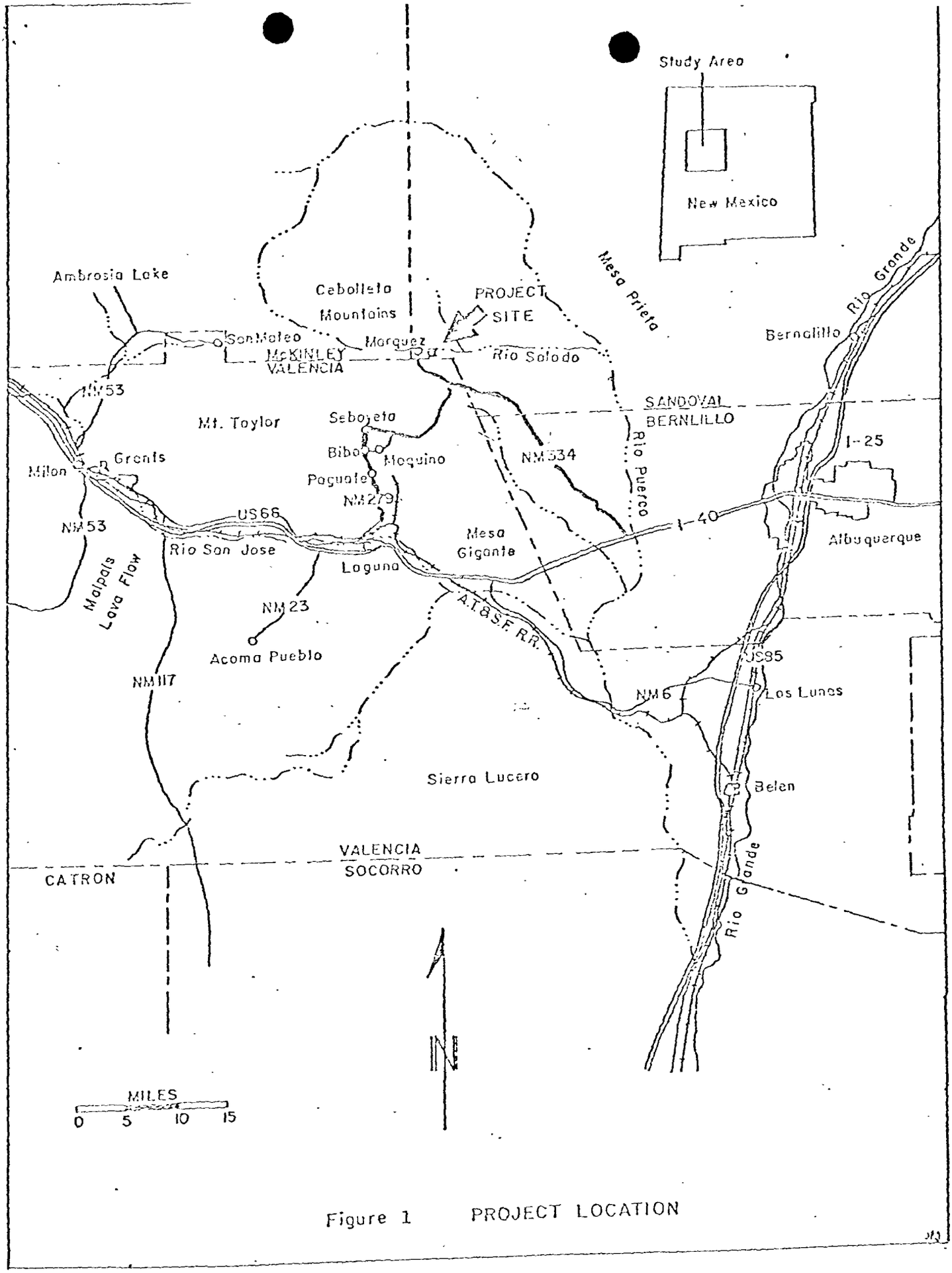

Figure 1 PROJECT LOCATION

2.2 METEOROLOGY

The general climate of the proposed Bokum mill site is arid continental. Seasonal and daily temperature ranges are relatively high, but extreme temperatures (greater than 100° F or less than 0° F) are rare. Clear weather predominates and sunshine occurs during 75% of the daylight hours. Wind movement averages 9 miles per hour with the higher wind speeds occuring in the late winter and early spring. Precipitation is light and the relative humidity averages less than 50%.

2.3 GEOLOGY

The site is located in the San Juan Basin, a structural depression which contains approximately 9,000 feet of sedimentary rock. Tectonic activity has resulted in folding and faulting northeast of the site, and volcanic eruptions are in evidence in the Mt. Taylor area to the west. Subsequent erosion has exposed Cretaceous or older rocks which now outcrop in the Basin.

In the mill tailings site area, the rock underlying most of the 5-20 foot alluvial cover is Mancos shale. Exceptions are gravels near arroyo banks which contain ground water during periods of high runoff. The Mancos formation consists of 15 - 25 feet of weathered shale which overlies 400 to 700 feet of unweathered shale. Overlying the Mancos shale is the Gallup sandstone, a resistant formation which forms the mesa where the mill site is located.

The recent geological history of the Marquez, Seco and Santa Rosa drainages involves a series of cycles of deposition and down-cutting. The present drainage occupies a steep to vertical stream channel which is the result of headcutting. Present headward cutting arroyos have in a few cases crossed into terraces between the Santa Rosa and Seco drainages where tailings disposal trenches and evaporation ponds will be located. Although the rate of movement of these headcuts has not been quantified, they appear to be "stalling out" where unweathered shale is encountered. Headcutting rates in weathered shale, where much of the below-grade tailings disposal will take place, have not been evaluated, but will be accomplished by the applicant under conditions of the Ground Water Discharge Plan.

2.4 SEISMOLOGY

Two zones of moderate seismicity are identified in the project area. The first zone is within 170 miles of the site, and in the central area of the zone eight earthquakes of Intensity V to VI (Modified Mercalli) have been recorded within 200 miles of the site.

A second earthquake zone comes within 40 miles of the site and is associated with north-south trending faults of the Rio Grande Rift Zone. Although most of the earthquakes associated with the zone have been low in magnitude and intensity, one earthquake in 1918 epicentered 51 miles east of the site and had an Intensity of VII to VIII. Faults in the rift zone have the capability to generate moderate to moderately large earthquakes.

A study of the area has concluded that a maximum probable seismic event equal to a Richter magnitude of 5.0 within 60 miles of the site within a period of 100 years is an appropriate estimate. Based on this study, a ground acceleration of 0.1 g is assumed for the construction of the secondary catchment dam and evaporation ponds. A stability analysis of the originally projected tailings dam indicates that it would be stable at 0.1 g of ground acceleration.

3. OPERATIONS

3.1 MINING ACTIVITIES

The Marquez Mine is located two miles west of the project site. At present a 14 foot inside diameter shaft is being sunk to a final depth of 2100 feet. The Bokum Resources Corporation will use the modified room and pillar method to mine the ore. Retreating will not occur until the extremities of the ore body have been reached in a particular area. The mine will operate three shifts per day, six days per week with the seventh day devoted to maintenance. Forced ventilation will be used to reduce radon in the mine operating areas. There will be five vents located between the mine site and about one-half mile west of Marquez.

3.2 MILL PROCESS AND CONTROLS

3.2.1 MILL PROCESS

Uranium will be extracted from ore in the following simplified process (Figure 2). Moist uranium ore will be delivered from the mine in ore trucks which will empty their loads upon the ore pad. A front end loader will then load the ore into the grinding hopper where the ore will be conveyor fed into a semi-autogenous mill and then through a rod mill providing a ground sandstone slurry product. This will be fed through a series of leach tanks where the slurry will be mixed with sulfuric acid.

The slurry will then be routed to the countercurrent decantation section where the uranium bearing liquor will be separated from the sandstone solids which will be transported to the tailings pond area. The uranium bearing liquor will then be run through a clarifier and filters and then routed to the solvent extraction circuit.

In the solvent extraction circuit, the uranium bearing liquor will be mixed with an organic solution composed of kerosene, an organic amine, and isodecanol. The amine will form a chemical complex with the uranium in the organic phase. The organic phase solution will then be routed to the stripping circuit. The barren liquor called raffinate having the uranium extracted from it will be routed to the countercurrent decantation section to be recycled as wash solution.

The stripping solution, sodium chloride, will strip the uranium from the organic phase. The uranium having passed into an acqueous phase at a higher concentration level will then be routed to the precipitation section where ammonia will be added to raise the solution pH to 7 to precipitate the uranium in the form of ammonium diuranate. This product will be washed then routed to the dryer where the product will be dried and calcined to remove the traces of ammonia left from the precipitation section. The final product, known as yellowcake, will then be packaged in 55 gallon drums and shipped to other facilities where further processing will be undertaken to produce a final product which will be used as fuel in nuclear reactors to generate electricity for the utility industry.

3.2.2 SAFETY INSTRUMENTATION AND CONTROLS

The mill design is such that any leaks or spills occurring throughout the processes will be collected and recycled to the appropriate processing stage.

All major processing buildings and equipment will be ventilated adequately dependent upon the nature and amount of gaseous effluents. All process gaseous effluent stacks will be designed to permit isokinetic stack sampling. The following will describe by appropriate operating section measures which will be utilized, where necessary, to control and minimize the effects of the mill effluents.

Ore Handling

The potential effluent in this processing section will be the release of dust from the stockpiled ore to the atmosphere. While the stockpiled ore is expected to be moist thus reducing the tendency for dust production during high wind conditions, the ore stockpiles will be sprayed with water to mitigate the production of dust if a problem arises.

Grinding

The small amounts of dust and radon gas resulting from the grinding operation will be collected and scrubbed through a wet scrubber handling 10,000 cubic feet per minute of air. Only a trace of dust is expected to exit the scrubber.

Any liquid slurry spills in the grinding section will be collected in a sump and recycled through the grinding process.

Leaching

All eight leach tanks will be covered. The leach vapors, anticipated to be CO_2, acid mist and chlorine in small quantities will be collected and wet scrubbed through a unit handling 5,000 cubic feet per minute.

Berms will be designed around all outside tanks to contain any spills which may result. Collected spills will either be recycled through the appropriate processing stage or will be collected and discharged to the tailings disposal area.

Precipitation and Packaging

The yellowcake dryer will be equipped with a high-efficiency wet scrubber handling 335 cubic feet of air per minute. The scrubber effluent will be recycled to the yellowcake wash thickeners. A separate dry dust collector will be provided for the packaging area. The dryer and packaging area will be enclosed with no exposed pipes or ductwork. The walls and ceilings will be sheathed to provide smooth surfaces that can be readily cleaned.

3.3 WASTE MANAGEMENT SYSTEMS

3.3.1 Mill Site

There will be no ore storage at the mine. Ore trucks will transport moist ore to the mill site where it will be deposited in a designated ore storage area. This area, which is south of the mill, is constructed to minimize the seepage into the ground under the ore. Since the ore is "wet", 8-10% moisture, there

will be minimum dust from the ore. If the ore becomes dry, the applicant will spray the ore to reduce dusting. Any run-off from the ore pads is collected and drains to the north. On the north edge of the mill there is a sump pond to collect the drainage from the ore pads and the mill circuits. This solution will be pumped to the mill tailings disposal area for evaporation.

Also collected is the laundry waste water, laboratory liquid wastes and sewage treatment waste solution. All of this liquid is pumped to the mill tailings disposal area.

Overall, this additional liquid waste is small when compared to the mill tailings solution developed from the mill operation. It is not expected to significantly affect the evaporation pond areas requirements.

4. RADIOLOGICAL IMPACTS OF OPERATIONS

4.1 GENERAL COMMENTS

This report summarizes the radiological impacts of the proposed Bokum mill based on conversations with the staff of the Nuclear Regulatory Commission (NRC) and the environmental report submitted by Bokum. Several sections depend on data developed by the Environmental Improvement Division (EID). The EID is currently performing its own radiological assessment, using MILDOS, the NRC computer model for uranium mills. Unfortunately, the period provided for doing this assessment has not been sufficient time for the EID staff to get the computer code running, become familiar with its techniques, and have confidence in its results. Some information generated by the EID staff in preparing to make the assessment is available, however, and will be used in what follows.

NRC

NRC staff members have unofficially indicated that they find no significant radiological hazard from the proposed mill. The area is relatively isolated with 43 people living within 10 miles of the mill site. Almost all of this population is located in the Town of Marquez, which, being northwest of the mill, is removed from the prevailing easterly wind direction. This tends to minimize radiation exposures from several pathways, such as inhalation.

One important exposure pathway is through ingestion. The range east of the mill is used for livestock grazing. Animals may feed on vegetation contaminated by wind-blown material from the mill, or may inadvertently swallow contaminated soil. The eventual human consumption of these animals would result in a radiation exposure to man. The NRC work has apparently found that exposures through ingestion are not significant.

NRC has found that one area near the mill site has a predicted Thorium-230 air concentration exceeding by 10-20% their 10 CFR 20 limit, which is identical to the New Mexico limit given in the New Mexico radiation protection regulations. Their recommendation is to require the mill to sample in that area regularly in order to detemine if a problem exists.

4.2 APPLICANT'S RADIOLOGICAL ASSESSMENT AND EVALUATION BY EID

4.2.1 BOKUM ENVIRONMENTAL REPORT

In the fall of 1979, Bokum submitted a radiological analysis performed by Science Applications, Inc. (SAI), their radiological contractor. It consisted of a computer calculation using the computer model UDAD, which in an earlier version was a predecessor of the NRC's MILDOS. The following is a critique of that work.

4.2.2 METEOROLOGICAL DATA

Bokum measured wind speed, wind direction, and stability class at two locations on the mill site: site #1, on top of Marquez Mesa near the

proposed mill buildings, and site #2, at the base of Marquez Mesa in the tailings disposal area. The reduced data was sent to SAI where it was used to calculate relative frequencies as a function of wind speed, wind direction, and stability class.

Several aspects of the data are questionable. In particular, Bokum has an unusually high occurence of Class "A" stability, which corresponds to the most instable atmospheric conditions. This class is characterized by a relatively high degree of atmospheric turbulence/mixing. Bokum's reported high frequency of Class "A" stability could cause predicted air concentrations to be underestimated. Correspondending to the high frequency of "A" stability, there is a lower frequency of "D" stability. The following table compares stability class data at several locations.

SITE	DISTANCE FROM BOKUM	STABILITY CLASS/FREQUENCY OF OCCURENCE A	B	C	D	E	F	G
Albuquerque	43 mi	.028	.138	.138	.362	.136	.132	.066
Sohio	8 mi	.015	.131	.133	.417	.143	.127	.034
Gulf	17 mi	.033	.114	.136	.382	.125	.103	.089
Anaconda	36 mi	.029	.049	.118	.348	.039	.061	.009
Bokum #1		.574	.117	.086	.085	.037	.100	
Bokum #2		.374	.124	.120	.198	.133	.051	

Bokum's 57.4% Class A stability at site #1 is some 19 times higher than the approximately 3% found at Sohio, Gulf, and Albuquerque.

We have discussed this data with the EID meteorology staff, who concur that the stability data is questionable. We have had several conversations with Bokum's meteorological consultant, SAI, and requested that the data be reexamined with a view to imposing strict quality assurance measures on the data reduction.

It has been suggested that some modification of the Sohio data may be used as a more accurate representation of the meteorology at the Bokum site. This alternative and several others are now being reviewed by the staff.

4.2.3 *SOURCE TERMS*

We have calculated the source terms, in curies/year, for four radionuclides for each source on the mill site. The calculations were based on raw data, supplied by Bokum in their April 18, 1979 letter to Alphonso A. Topp, Jr., which described the mill operations and the characteristics of their effluent control facilities.

These source terms are compared with the source terms used by Bokum in their UDAD run:

SOURCE		CURIES/YEAR				
ORE-HANDLING		URANIUM	THORIUM-230	RADIUM-226	LEAD-210	RADON 222
	EID	.0223	.0223	.0223	.0223	0.0
	BOKUM	0.0	0.0	0.0	0.0	0.0
ORE PAD						
	EID	Calculated by MILDOS				70.3
	BOKUM	.0076	.0076	.0076	.0076	9.9
GRINDER						
	EID	.171	.171	.171	.171	30.4
	BOKUM	.0023	.0023	.0023	.0023	.592
LEACHING						
	EID	0.0	0.0	0.0	0.0	.1
	BOKUM	0.0	0.0	0.0	0.0	.1

CURIES/YEAR

SOURCE		URANIUM	THORIUM-230	RADIUM-226	LEAD-210	RADON 222
CCD						
	EID	0.0	0.0	0.0	0.0	0.33
	BOKUM	0.0	0.0	0.0	0.0	0.33
DRYING & PACKAGING						
	EID	.340	.017	.00007	.00007	0.0
	BOKUM	.0362	.000036	.000036	0.0	0.0
TAILINGS TRENCH #1						
	EID	Calculated by MILDOS				151.0
	BOKUM	.0000395	.000536	.000564	.000564	50.2
TAILINGS TRENCH #2						
	EID	Calculated by MILDOS				509.5
	BOKUM	.0000395	.000536	.000564	.000564	50.2
MINE VENTS						
	EID					6570
	BOKUM					0

The EID source terms are uniformly higher than those used by Bokum in their radiological assessment. Several of the EID source terms, such as the uranium emission from the drying and packing area, have been discussed with and confirmed by the NRC.

4.2.4 OMITTED IMPORTANT EXPOSURE PATH-WAYS

The Bokum radiological assessment has omitted the ingestion pathway as a source of radiation exposure. The pathway would include exposure scenarios such as the human consumption of meat or milk from cattle who have grazed in areas contaminated by the mill operations, or of vegetables grown in those areas. Since the area downward from the mill and tailings area, generally east of Bokum's facility, is used for livestock grazing, this pathway must be adequately evaluated.

4.3 STAFF COMMENTS ON APPLICANT'S RADIOLOGICAL ASSESSMENT

There is not enough information presently available to predict the radiation doses due to the proposed facility. The Bokum assessment has several deficiencies noted above, while the NRC report has not yet been received. The EID has completed part of the radiological assessment, including the calculation of source terms, evaluation of meteorological data, and successful computer runs performing dose calculations. However, this work is still in a preliminary form. There are additional staff concerns about the adequacy of the meteorological data submitted by the mill.

It is important that accurate meteorological data be supplied to the staff by the company so that the dose assessment can be performed. In collecting the data, the company should be required to adopt a sound quality assurance program both for data collection and data analysis. This program should be documented and sent to the EID for review.

Equally important is the siting of the meteorological monitoring equipment. The company should submit a map showing the exact locations of the monitoring sites. Because of the complex terrain around the mill site, meteorological data should be collected at the mill site, in the tailings area, and in the town of Marquez. The location of Bokum site number 1 at the mill appears satisfactory, but the location of Bokum site number 2 in the tailings area has not been formally identified, making use of data from site 2 questionable. No data has been taken yet at Marquez.

Bokum should review its radiological assessment using source terms consistent with the raw data supplied to the EID on April 18, 1979, or indicate why their source terms are preferable to those calculated from those data.

Bokum should perform a radiological assessment that includes all significant exposure pathways, especially ingestion. It should calculate doses at several critical locations around the mill, such as at the closest residence, at the closest down-wind residence, and at their fence lines.

5. NON-RADIOLOGICAL IMPACTS OF OPERATIONS

5.1 Air Quality

The short-term increases in suspended particulates during plant construction and the increases in suspended particulates and chemical emissions associated with mill operations are not expected to adversely affect regional air quality. Operations of mills, exclusive of tailings, at other sites and significantly higher throughput have not degraded the local air quality. Wet tailings deposition in below grade trenches significantly reduces any degradation of air quality.

5.2 Land Use

The primary land use of the Juan Tafoya Grant prior to uranium development was livestock grazing. About 100 head of cattle are grazed on 3800 acres. Of the 1000 acres under lease to Bokum Resources Corporation, the land on which the mill is located could be returned to a pre-mill condition by reclamation. However, the tailings area, potentially 548 acres, under present regulations and technology may be unavailable for further range use.

While uranium milling is short-term, a mill tailings disposal site will constitute a permanent disturbance of the land surface, rendering it unsuitable for further archeological investigation.

5.3 Mineral Resources

No mineral resources are known to exist on the site. Recycling of tailings for extraction of other minerals, such as vanadium, could occur if economics warrant.

5.4.1 Soils

Construction and operation of the mill facility will disturb topsoil as it is removed from construction areas and stockpiled for revegetation upon termination of operations. A temporary decrease in natural soil productivity is inevitable. Some soil will be lost due to wind and water erosion but proper mitigating measures will minimize this loss.

Bokum Resources Corporation's reclamation plan is designed to return the soils to a condition consistent with the historic usage of livestock and wildlife grazing and habitat. The program will begin as soon as practicable and will continue through the lifetime of the mill. As a result, almost half of the disturbed soils should be back in production by the time mill operations cease.

5.4.2 Biota

The proposed project will result in the loss of vegetation and wildlife. Revegetation of disturbed areas will begin as soon as practicable and will continue throughout the life of the project. Almost half the disturbed area will be revegetated by the time mill operations cease and the remainder will be revegetated as soon as practicable.

Wildlife now inhabiting the project site will either perish or escape to undisturbed areas. After reclamation, the more adaptable species will repopulate the area as favorable stages in the vegetative succession are reached. If revegetation is not successful for reclaimed areas, these areas will be protected to minimize intrusion by wildlife.

5.5 SOCIOECONOMIC CONDITIONS

Because of the location of the Marquez Uranium Mine and Mill on leased Juan Tafoya land grant, no significant impact is anticipated in the immediate vicinity.

Personnel involved in project operation are now and are expected to be commuting from surrounding areas.

5.6 EFFECTS OF ACCIDENTS

The potential for environmental effects from accidents involving nonradioactive materials at the Marquez Uranium Mill is small. Failure of a boiler supplying process stream could release low-pressure steam to the room, possibly causing injuries to workers, but would not involve the release of radioactivity or chemicals to the environment. Forced-air ventilation systems are provided in several stages of the process to dilute the chemical vapors emitted and protect the workers from the hazardous fumes. Failure of these ventilation systems might result in the localized collection of these vapors in the building air. Such a failure might effect individual plant employees but would have no persistent effect on the environment.

A number of chemicals such as ammonia, kerosene, sulfuric acid, sodium chlorate and diesel oil used in the process will be stored in relatively large quantities on the site. Minor leaks and spillage of reagents will be captured in sumps and returned to the mill circuit or tailings trenches. Major spills could flow across the mill site and enter the drainage berms to the mill sump for pumping to the tailings disposal area. An ammonia spill would result in ammonia vapor dispersed to the environment. The resultant concentrations would be quite low and offsite consequences are expected to be negligible.

Accidents involving releases of radioactive material will be analyzed in the applicant's emergency response plan.

5.7 MONITORING PROGRAMS

A preoperational monitoring program is being conducted at the Marquez Uranium Mill site to establish baseline radiation levels and concentrations occuring in air, biota, soil and water. The sampling program is ongoing and results are incomplete as of the present date. The preoperational monitoring program is modeled after the Draft Generic Environmental Impact Statement on Uranium Milling (GEIS), Table 10.1, with certain site specific modifications.

The objectives of the operational monitoring program are to ensure that the Marquez Uranium Mill discharges are as low as reasonably achievable. The procedures for performing monitoring will be compared with the GEIS Table 10.3. In addition, Bokum Resources Corporation is required by license condition to submit to the Division within 60 days after January 1 and July 1 of each year a report that specifies the quantity of each of the principal radonuclides released to unrestricted areas during the previous six months.

6. IMPACT OF OPERATIONS ON WATERWAYS OR GROUNDWATER

6.1 SURFACE WATER

The site lies near the confluence of three major streams: the Canon Seco, the Canon de Marquez and the Canon de Santa Rosa. These streams flow into Salado Creek which is a tributary of the Rio Puerco.

Peak stream discharges and flood volumes for the 100 year and the probable maximum flood (PMF) series are calculated for five locations adjacent to the tailings disposal area. These calculations are based on watershed catchment areas of 11.2 mi^2 for the Canon de Marquez, 17 mi^2 for the Canon de Santa Rosa, and 1.4 mi^2 for the Arroyo Hondo.

A probable maximum precipitation of 11.0 inches for a one-hour period is assumed, and a 17.3 inch total rainfall is used for the calculation of the PMF. A probable maximum flood peak of 35,500 cfs (volume of 4,410 acre-feet) is calculated for the point where contributing drainage is combined and directed by the diversion ditch.

Within the containment area between the diversion ditch and the downstream secondary catchment dam, a pool area of 418 acres has been calcualted for a PMF associated with 17.3 inches of precipitation. This pool would contain about 603 acre-feet of water at a height expected to be at a minimum of at least six feet below the crest of the secondary catchment dam.

6.2 GROUNDWATER

An aquifer, Point Lookout sandstone, to the west and above the mill contributes approximately 25 gpm. The mill is located on the Gallup sandstone which provides water for the community of Marquez.

The tailings disposal site is underlain by 2 to 35 feet of alluvial deposits in which groundwater moves freely in the Canon Seco and the Canon de Santa Rosa. Groundwater in Arroyo Hondo and Canon de Marquez will be partially intercepted by the diversion system.

The tailings disposal site is located on the Mancos shale which contains water-bearing sandstone members such as the Tres Hermanos. Below this shale, at a depth 1,200 - 1,400 feet, lies one of the principal aquifers of McKinley County, the Westwater Canyon sandstone.

The aquifer most likely to be affected by seepage is the alluvial channel material in arroyos such as the Canon de Marquez. This material consists of sands which carry a small amount of good quality water (TDS 2000-4000 mg/l). This aquifer is adjacent to operating areas and requires special safeguards, including interception ditches near disposal trenches and the secondary catchment dam to prevent groundwater movement into and out of the disposal area.

Rates of groundwater movement are very low in the unweathered shale (10^{-9} cm/sec) and nearly as low in recompacted weathered shale (10^{-8} cm/sec). The Mancos shale is fractured in both weathered and unweathered forms, which increases permeability. Rates of movement of 25.7 ft/yr (upper limit) for the weathered shale and a range of 2.7 to 28.0 ft/yr for unweathered shale are reported in areas where fractures are suspected.

The uranium tailings material, which is designated for disposal in below-grade trenches, is estimated to have a permeability of 1.56 ft/day, resulting in an outflow of 8,680 gal/day of liquid. This flow is expected to rapidly decant the liquid for transfer to the evaporation pond.

7. LONG TERM EFFECTS

7.1. DECOMMISSIONING

A mill decommissioning plan is required to be submitted to the Division three years prior to termination of operations for review and approval.

7.2. DECONTAMINATION

Contaminated equipement will be decontaminated prior to release for unrestricted use in accordance with procedures established by regulations in effect at the time of proposed release. Materials which cannot be decontaminated shall be disposed of in the tailings trenches or shipped to an approved disposal site.

7.3 RECLAMATION PLAN

With the below-grade tailings disposal system, reclamation is an ongoing process which will be initiated 6 to 9 months after mill startup when trench #1 is filled. Reclamation design for each site will be supervised by a range specialist and an engineer or geologist. Annual status reports will be prepared.

Evaporation ponds will be reclaimed at the end of milling operations. The compacted shale and contaminated residue will be removed and buried in the final trench and the pond areas resloped to an appropriate grade determined by experimental research to minimize erosion, and then revegetated. Topsoil removed in pond construction will be stock piled, protected and reused. Irrigation will be used during revegetation.

Trenches will be covered with a minimum of 10 ft. of spoil material plus top soil and sloped to an appropriate grade determined by experimental research (in any case not greater than 1:10). The reclaimed surface will be broadly convex and will avoid the concentration of surface runoff. Drainage will discharge on a rip-rap surface upon entering the Santa Rosa channel. Arroyos extending towards reclaimed areas will be filled, buried under soil, plugged with compacted clay, and riprapped along the Santa Rosa and Canon de Marquez channels. As each segment of the area is filled with spoil it will be graded to the appropriate slope, covered with top soil and revegetated.

Geomorphological and engineering criteria in the stabilization of headward-moving arroyos include the following: 1) avoidance of surface runoff concentration; 2) stabilization of the base of slopes adjacent to major arroyos; 3) use of small drainage basins to collect runoff; 4) clearing of flow blockage from the Canon de Marquez when the natural drainage system is restored at the close of operations.

Following operations, streams will be allowed to reestablish their original courses, and measures will be taken to reduce arroyo headcutting which could accompany the increased streamflow. The diversion system will be plugged north of the unnamed arroyo which lies north of Arroyo Hondo. The diversion will be sloped to the south, opened through the Canon de Marquez and allowed to carry the drainage of the unnamed arroyo, Arroyo Hondo and Canon de Marquez. The secondary catchment dam will be opened to allow flow of all streams into Salado Creek. North of the plug, the diversion channel will be retained to remove the drainage west of the diversion and to aid in the protection of the trench area from headward cutting arroyos.

8. ALTERNATIVES CONSIDERED

8.1 NO LICENSING ACTION

An ore body of average uranium ore grade of approximately .08 to 0.10% is located in the Marquez area. Mining operations are being developed to bring the ore to the surface by Bokum Resources Corporation and others. The nearest operating uranium mill is about 15 miles south and located on the L-Bar Ranch. Other mills are located in the Milan area, approximately 50 miles away. Considerable transportation of ore would be necessary to get the ore from the mines to a mill. No licensing action would also require ore storage at the mines. The mill is over 90% completed at this time and is a modern extraction facility designed to minimize environmental impacts, therefore, it is considered that no licensing action would be detrimental. No production of uranium "yellowcake" might reduce the fuel available for nuclear reactors and curtail electric power output.

8.2 ALTERNATIVE SITES

The original alternative site study was accomplished for above grade tailings impoundment facility using an engineered earth dam. Since the volume of tailings solids and liquids remain the same, the basic criteria is generally applicable to below grade disposal.

The various potential sites for tailings disposal were identified by BRC. The following factors were considered by BRC in evaluating the advantages and disadvantages of each site:

Cost of construction and reclamation
Dam height and crest elevation
Surface area for evaporation
Tailings storage capacity
Surface rights
Tailings transfer distance
Distance to downstream boundary
Distance to nearest boundary
Containment for tailings if a slurry line breaks
Ore reserves
Geologic stability
Seepage potential
Flood management during operation
Radiation exposure

Overall eight site arrangements were reviewed. All the above features were considered by BRC for comparison. The proposed site met most of the necessary factors for tailings disposal. In addition, in considering the proposed NRC and EID tailings management objectives, these can be summarized as follows in relation to the proposed site and "below grade" tailings disposal:

1. Located in a remote area to reduce potential population exposures to the maximum extent reasonably achievable. The rugged range area around Marquez is very lightly populated. The population is at a distance from the mill where potential population exposures are minimized.

2. Tailings area isolated as much as practical so that disruption and dispersion by natural forces is reduced to the maximum extent reasonably achievable. The below-grade disposal trenches and evaporation ponds are sited to minimize natural disruptive forms.

3. Reduce seepage to the maximum extent reasonably achievable. The placement of tailings solids in Mancos shale will minimize seepage.

4. Minimize blowing of tailings to unrestricted areas during normal operations by maintaining the location of tailings solids in deep pits, the moist condition, and early reclamation coverage with earth.

5. Reclamation designed to reduce gamma to background, radon emanation rate to about 2 picocuries per square meter per second, and minimize the need for ongoing monitoring and maintenance program. Coverage of tailings solids by greater than 10 feet of earth and slope grading of 1:10 with rerouting of Arroyo Hondo should assist in meeting this objective.

By use of trenches for storage of dewatered tailings; maximum reduction of seepage, blowing of tails and disruption is provided. On-going reclamation program evaluation during mill operations provides maximum knowledge and evaluation of reclamation effectiveness.

8.3 ALTERNATIVE ENGINEERING METHODS

Selection of the sulfuric acid leach/solvent extraction process for uranium ore has set the tailings discharge process to the handling of a slurry of solids. and low ph acid solution. The use of below-grade trenches and evaporation ponds as proposed by the applicant, appears to be a reasonable solution to meet the current policy of below-grade disposal of uranium mill tailings. Due to the erosional characterization of this site, an on-going evaluation of the proposed reclamation program is vital.